AP Chemistry Summer Assignment

AP Chemistry Student,

Welcome to AP Chemistry! I am eagerly anticipating a great year of Chemistry. In order to ensure the best start for everyone next fall, I have prepared a summer assignment that reviews basic chemistry concepts. Much of the material in this summer packet will be familiar to you. It will be important for everyone to come to class the first day prepared. While I review, extensive remediation is not an option as we work towards our goal of being 100% prepared for the AP Exam in early May. There will be a test covering the basic concepts included in the summer packet during the first or second week of school.

You may contact me by email: (lomccoy@cliftonschools.net) this summer. I will do my best to answer your questions ASAP.

Finally, I recommend that you spread out the summer assignment. Please do not try to complete it all in the final week of the summer. Chemistry takes time to process and grasp at a level necessary for success in AP Chemistry. Remember, AP Chemistry is an equivalent course to Introductory Chemistry in college. Taking a college level course in high school is difficult, requires dedication, and is a great investment in your education so prepare yourself and arrive ready to learn.

Important information:

- You will need a scientific or graphing calculator
- **You will need a bound composition notebook for use as a lab notebook.**
- Your class notebook can be whatever you are most comfortable with. You may want a binder (or several) for the copious worksheets and handouts.

Have a great summer!

Dr. McCoy

<u>The following assignment is to be completed *on lined paper* for the first day of school. YOU MUST SHOW WORK FOR ALL PROBLEMS.</u> Questions cover topics from general chemistry to basic mole concepts. Certain topics will be reviewed during regular school year. You will hand in only the lined paper with your work on it and the signed safety contract in September. Good Luck!

1. Use factor labeling (dimensional analysis) method to convert the following:
   a. 515 m = ___ miles.
   b. 200 in = ____ meters
   c. 325 days = _____ seconds.
   d. 20 gallons = _____ ml

2. Classify each of the following as units of mass, volume, length, density, energy, or pressure.
   a.mg b. mL c. cm^3 d. mm e. kg/m^3 f. kJ g. atm h. cal.

3. A cylinder rod formed from silicon is 21.3 cm long and has a mass of 5.00 kg. The density of silicon is 2.33 g/cm^3. What is the diameter of the cylinder? (the volume of cylinder is given by $\pi r^2 h$, where r is the radius and h is the length)

4. How many significant figures are in each of the following?
   a. 1.92 mm b. 0.030100 kJ c. 6.022×10^{23} atoms
   d. 460.00 L e. 0.00036 cm^3 f. 100
   g. 1001 h. 0.001 i. 0.0101

5. Record the following in correct scientific notation:
   a. 350,000,000 cal
   b. 0.0000721 mol
   c. 0.0000000809 Å
   d. 765,400,000,000 atoms

6. Calculate the following to the correct number of significant figures.
   a. 1.27 g / 5.296 cm^3
   b. 12.235 g / 1.01 L
   c. 12.2 g + 0.38 g
   d. 17.3 g + 2.785 g
   e. 2.1 x 3.21
   f. 200.1 x 120
   g. 17.6 + 2.838 + 2.3 + 110.77

7. Give the chemical symbols for the following elements:
   a. Carbon b. sulfur c. Titanium d. Nitrogen e. Helium f. Krypton g. Fluorine
   h. Scandium i. Arsenic

8. Write the name for each of the elements symbols:
   a. Na b. Au c. Ag d. Sn e. Fe f. Hg g. K

9. Label each of the following as either a physical process or a chemical process.
   a. corrosion of aluminum metal. b. Melting of ice.
   c. Pulverizing an aspirin. d. Digesting a candy bar.
   e. Explosion of nitroglycerin. f. Milk turning sour.
   g. Burning of paper. h. Forming of frost on a cold night.
   i. Bleaching of hair with hydrogen peroxide. j. A copper wire is hammered flat.

10. Calculate the mass of O_2 produced if 3.450 g potassium chlorate is completely decomposed by heating in presence of a catalyst (Manganese dioxide).

11. Write the formula of the following compounds? (Use criss- cross method)
    a. Calcium sulfate. b. Ammonium Phosphate c. Lithium Nitrite

    d. potassium perchlorate. e. Barium Oxide f. Zinc sulfide.

    g. Sodium Perbromate i. Calcium Iodide j. Aluminum Carbonate.

12. Convert 6.75 atm to: (Using factor-labeling method)

    a. mm Hg b. pascals

13. White gold is an alloy that typically contains 45.0% by mass gold and the remainder is platinum. If 154 g of gold are available, how many grams of platinum are required to combine with the gold to form this alloy?

14. What is the empirical formula of a compound that contains 53.73% Fe and 46.27% of S ?

15. Determine the number of molecules present in 4.56 mol of nitrogen (N_2).

16. List the following as diatomic molecule, molecular compound, ionic compound or element.
    a. F_2 b. Cl_2 c. C d. NaCl e. KF f. CO_2 g. H_2 h. Ag
    i. Rust (Fe_2O_3) j. MgO k. O_2 l. I_2 m.CO n. K_2CO_3

17. Calculate the mass in grams of each of the following:
    a. 6.02×10^{23} atoms of Mg.
    b. 3.01×10^{23} Formula units of $CaCl_2$.
    c. 12.4×10^{15} atoms of neon.

18. In an experiment, a student gently heated a hydrated copper compound to remove the water of hydration. The following data was recorded:
    1. Mass of crucible, cover, and contents before heating 23.4 g.
    2. Mass of empty crucible and cover 18.82 g.
    3. Mass of crucible, cover, and contents after heating to constant mass 20.94 g.

    Calculate the experimental percent of water in the compound.

19. An extensive property is one that depends on the amount of the sample. Which of the following properties are extensive?

    a. volume b. density c. temperature d. energy e. melting point. f. pressure

20. Name the types of general inorganic reactions with example of each?

21. What mass of copper is required to replace silver from 4.00g of silver nitrate dissolved in water?
    $Cu(s) + AgNO_3 \rightarrow Cu(NO_3)_2 + Ag.$

22. Write the chemical formulas for the following compounds:
    a. Calcium carbonate b. Ammonium phosphate c. Sodium chloride d. Sodium oxide e. Calcium sulfate f. Sodium nitrite g. Magnesium acetate h. Potassium cyanide i. Zinc(II) nitrate j. Iron(III) phosphate k. Nickel (II) fluoride

23. Strontium consists of four isotopes with masses and their percent abundance of 83.9134 amu (0.5%), 85.9094 amu (9.9%) , 86.9089 amu (7.0 %) , and 87.9056 amu (82.6 %). Calculate the atomic mass of Sr ?
24. Mercury has an atomic mass of 200.59 amu. Calculate the
    a. Mass of 3.0×10^{10} atoms.
    b. Number of atoms in one nanogram of Mercury.

25. Convert the following to moles
    a. 3.86 grams of Carbon dioxide.
    b. 6.0×10^{5}g of Hydrazine ($N_2 H_4$), a rocket propellant.

26. The molecular formula of morphine, a pain-killing narcotic, is $C_{17}H_{19}NO_3$.
    a. What is the molar mass?
    b. What fraction of atoms in morphine is accounted for by carbon?
    c. Which element contributes least to the molar mass?

27. Complete the list of ionic compounds (name or formula)
    a. Cupric Hydroxide
    b. Strontium Chromate
    c. Ammonium Per chlorate
    d. $NaHCO_3$
    e. $Fe_2 (CO_3)_3$
    f. Sodium Hydroxide.
    g. Potassium Chloride.

28. The hormone, thyroxine is secreted by the thyroid gland, and has the formula: $C_{15}H_{17}NO_4I_4$. How many milligrams of Iodine can be extracted from 15.0 grams of thyroxine?

29. Calculate the percentage by mass of the following compounds:
    a. SO_3 b. CH_3COOCH_3 c. Ammonium Nitrate.

30. Determine the empirical formula of the compounds with the following compositions by mass:
    a. 10. 4 % C, 27. 8% S , 61. 7 % Cl
    b. 21.7 % C, 9.6 % O, and 68.7 % F

31. Vanillin, a flavoring agent, is made up of carbon, hydrogen, and Oxygen atoms. When a sample of Vanillin weighing 2.500g burns in Oxygen, 5.79 g of carbon dioxide and 1.18 g of water are obtained. What is the empirical formula of Vanillin?

32. Write a balanced equation for the following:
    a. Reaction of boron trifluoride gas with water to give liquid hydrogen fluoride and solid boric acid,(H_3BO_3).
    b. Reaction of magnesium oxide with Iron to form Iron (III) Oxide and Magnesium.
    c. The decomposition of dinitrogen oxide gas to its elements.
    d. The reaction of calcium carbide solid with water to form calcium hydroxide and acetylene (C_2H_2) gas.

e. The reaction of solid calcium cyan amide ($CaCN_2$) with water to from calcium carbonate and ammonia gas.
f. Ethane (C_2H_6) burns in air (Oxygen).
g. Hydrogen reacts with oxygen to from Water.
h. Nitrogen gas reacts with Hydrogen to form Ammonia.
i. Hydrogen reacts with Iodine gas to form Hydrogen Iodide.
j. Sodium reacts with Iodine gas to form Sodium Iodide.
k. Sodium Oxide reacts with water to form sodium hydroxide.
l. Carbon dioxide combines with water to form carbonic acid.
m. Magnesium and nitrogen gas combine to form magnesium nitride.
n. Conc. Hydrochloric acid reacts with Conc. Sodium hydroxide to form sodium chloride and water.

33. Sodium hydroxide reacts with carbon dioxide as follows:

$2\ NaOH(s) + CO_2(g) \rightarrow Na_2CO_3(s) + H_2O(l)$

Which reagent is the limiting reactant when 1.85 mol of sodium hydroxide and 1.00 mol carbondioxide are allowed to react? How many moles of sodium carbonate can be produced? How many moles of the excess reactant remain after the completion of the reaction?

34. WHEN benzene (C_6H_6) reacts with bromine (Br_2) bromobenzene(C_6H_5Br) is obtained:
$C_6H_6 + Br_2 \rightarrow C_6H_5Br + HBr$

a. What is the theoretical yield of bromobenzene in this reaction when 30.0 g of benzene reacts with 65.0 g of bromine?
b. If the actual yield of bromobenzene was 56.7 g what was the percentage yield?

35. Chlorine and Fluorine react to form gaseous chlorine trifluoride. You start with 1.75 mol of chlorine and 3.68 mol of fluorine.
a. Write the balanced equation for the reaction.
b. What is the limiting reactant?

36. When Hydrogen sulfide gas, H_2S, reacts with oxygen, Sulfur dioxide gas and steam are produced.
a. Write the balanced chemical equation for this reaction.
b. How many liters of sulfur dioxide would be produced from 4.0 l of Oxygen? Assume 100% yield and that all gases are measured at the same temperature and pressure.

37. Name the following: a. CO_2 b. P_4S_{10} c. NI_3 d. PCl_5 e. CCl_4 f. SF_6

38. A sample of carbon dioxide gas, CO_2 (g), occupies a volume of 5.75 L at 0.890 atm. If the temperature and the number of moles remain constant, calculate the volume when the pressure
a. increased to 1.25 atm
b. decrease to 0.350 atm

39. On a warm day, an amusement park balloon is filled with 47.8 g He. The temperature is 33˚C and the pressure in the balloon is 2.25 atm. Calculate the volume of the balloon.

AP questions will challenge you to think! Do not panic if you cannot answer the questions that follow as quickly as the ones above.

40. A mixture consisting of only sodium chloride (NaCl) and potassium chloride (KCl) weighs 1.0000 g. When the mixture is dissolved in water and an excess of silver nitrate is added, all the chloride ions associated with the original mixture are precipitated as insoluble silver chloride (AgCl). The mass of the silver chloride is found to be 2.1476 g. Calculate the mass percentages of sodium chloride and potassium chloride in the original mixture.

41. A salt contains only barium and one of the halide ions. A 0.1480 g sample of the salt was dissolved in water and an excess of sulfuric acid was added to form barium sulfate, which was filtered, dried and weighed. Its mass was found to be 0.1660 g. What is the formula for the barium halide?

42. A 5.000 gram sample of a dry mixture of potassium hydroxide, potassium carbonate and potassium chloride is reacted with 0.100 L of 2.00-molar HCl solution. A 249.0 mL sample of dry carbon dioxide gas, measured at 22.0 °C and 740.0 torr, is obtained from this reaction. What was the percentage of potassium carbonate in the mixture?

43. A 4.000 g sample of M_2S_3 is converted to MO_2 and loses 0.277 g. What is the atomic weight of M?

44. Two different chloride compounds of platinum are known, compound X and Y. When 3.45 g of compound X is heated, 2.72 g of compound Y is formed along with some chlorine gas. Upon further heating, the 2.72 g of compound Y is decomposed to 1.99 g of platinum metal and some more chlorine gas. Determine the formulas of compounds X and Y.

45. Ammonia is produce industrially by reacting
    $N_2 + 3H_2 \text{ ---> } 2NH_3$
    Assuming 100% yield, what mass of ammonia will be produced from a 1:1 molar ratio mixture in a reactor that has a volume of 8.75×10^3 L under a total pressure of 2.75×10^7 Pa at 455 °C.

46. Water is added to 4.267 g of UF_6. The only products of the reaction are 3.730 g of a solid containg only uranium, oxygen, and fluorine and 0.970 g of a gas. The gas is 95.0% fluorine and the remainder is hydrogen.
    a) What fraction of the fluorine of the original is in the solid and what fraction in the gas after the reaction?
    b) What is the formula of the solid product?

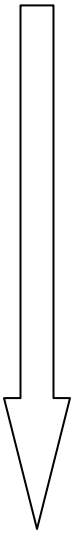
47. A compound containing titanium and chlorine is analyzed by converting all the titanium into 1.20 g of titanium dioxide and all the chlorine into 6.45 g of AgCl. What is the empirical formula for the original compound?

48. An unknown element X is found in two compounds, XCl_2 and XBr_2. In the following reaction:
    $XBr_2 + Cl_2 \text{ ---> } XCl_2 + Br_2$
    when 1.5000 g XBr_2 is used, 0.8897 g XCl_2 is formed. Identify the element X.

Memorize these!

Strong Acids:	**Strong Bases:**
HCl	LiOH
HBr	NaOH
HI	KOH
H_2SO_4	RbOH
HNO_3	CsOH
$HClO_4$	$Ca(OH)_2$
$HClO_3$	$Sr(OH)_2$
	$Ba(OH)_2$

Intermolecular Forces (forces between molecules that keep solids together)

Network Covalent	Directional covalent bonds C (graphite, diamond) Si, SiO_2(sand)	Strongest  Weakest
Ionic (electrostatic attraction)	Forces between adjacent ions (Na^+ and Cl^-)	
Metallic	Forces between metal nuclei (Cu, Ag)	
Hydrogen bonding	Forces between adjacent molecules with H & F, O, N or Cl. (H_2O, NH_3)	
Dipole-dipole	Forces between adjacent polar molecules (CO, NF_3)	
London Dispersion Force	Forces between adjacent non-polar molecules (CO_2, Cl_2)	

+	1-	2-	3-
NH_4^+ Ammonium	H_2PO_3 dihydrogen phosphite	HPO_3 hydrogen phosphite	PO_3 phosphite
H_3O^+ Hydronium	H_2PO_4 dihydrogen phosphate	HPO_4 hydrogen phosphate	PO_4 phosphate
Hg_2^{2+} Mercury (I)	HCO_3 hydrogen carbonate *Also known as* ***bicarbonate***	CO_3 carbonate	PO_2 hypophosphite
	HSO_3 hydrogen sulfite	SO_3 sulfite	AsO_3 arsenite
	HSO_4 hydrogen sulfate	SO_4 sulfate	AsO_4 arsenate
	NO_2 nitrite	S_2O_3 thiosulfate	
	NO_3 nitrate	SiO_3 silicate	
	OH hydroxide	C_2 carbide	
	CrO_2 chromite	C_2O_4 oxalate	
	CN cyanide	CrO_4 chromate	
	O_2 superoxide	Cr_2O_7 dichromate	
	MnO_4 permanganate	$C_4H_4O_6$ tartrate	
	ClO hypochlorite	MoO_4 molybdate	
	ClO_2 chlorite	O_2 peroxide	
	ClO_3 chlorate	S_2 disulfide	
	ClO_4 perchlorate		
	BrO hypobromite		
	BrO_2 bromite		
	BrO_3 bromate		
	BrO_4 perbromate		
	IO hypoiodite		
	IO_2 iodite		
	IO_3 iodate		
	IO_4 periodate		
	AlO_2 aluminate		
	CH_3COO acetate (CH_3CO_2 or $C_2H_3O_2$)		
	N_3 azide		